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TOXICITY OF COPPER SULPHATE ON SOME HAEMATOLOGICAL PARAMETERS OF A FRESHWATER TELEOST *CYPRINUS CARPIO* VAR. *COMMUNIS*

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ABSTRACT

Heamtological changes in a freshwater teleost, *Cyprinus carpio* Var *communis*, exposed to acute and sublethal toxicity of copper sulphate were studied. During the acute treatment, erythrocyte and leucocyte count, and haemoglobin content increased, whereas during the sublethal treatment, erythrocyte count and haemoglobin content decreased, and leucocyte count increased.

Keywords : Copper sulphate, erythrocyte, leucocyte, haemoglobin

Rapid industrialization and constant discharge of effluents in aquatic ecosystems are important causes of heavy metal pollution of aquatic bodies (Salunk *et al.*, 1982). Among heavy metals, copper is at present receiving the topmost attention in view of its high toxicity at relatively low concentration and a long biological half life resulting in a cumulative effect in fish (Wong *et al.*, 1977). Alabaster and Lloyd (1982) observed that copper is found in natural waters as a trace metal, i.e., usually at concentrations < 5mg/l, but can also be present at much higher concentrations as a result of mining activities and other industrial processes to the level of the detriment to fish.

Wedemeyer (1970) stated that haematological evaluation of fish blood provides valuable information concerning the physiological responses of fish to changes in the external environment. The blood parameters of diagnostic importance are erythrocyte and leucocyte counts and haemoglobin and haematocrit values. They readily respond to incidental factors such as physical stress - sampling and handling (Railo *et al.*, 1985) and environmental stress (pesticides, metals and effluents) due to water contaminants (Buckley, 1977). Hence, the present study has been made to find the haematological changes in fish, *Cyprinus carpio,* due to copper sulphate toxicity.

Cyprinus carpio var. *communis* were collected from Tamil Nadu Fisheries Development Corporation Limited, Aliyar Fish Farm, Aliyar, Tamil Nadu, and acclimatized to laboratory conditions for two weeks. During this period the fish were fed *ad libitum* with rice bran and groundnut oil cake. Water was changed

daily and aerated to ensure sufficient oxygen supply. The tap water was analysed for physico-chemical features following APHA (1971) and the values were : pH 7.2 ± 0.1; temperature 25.0 ± 2.0 °C; dissolved oxygen 6.2 ± 0.02 mg/l; salinity 0.6 ± 0.01 ‰, total hardness 18 ± 0.5 mg/l and alkalinity 17.5 (170 - 180) mg/l. The healthy fish with an average weight of 4 g and length of 7-8 cm was selected for the experimental purpose. The LC_{50} of copper sulphate for 24 hours is 0.55 mg/l (Finney, 1978). One tenth of the acute value (0.055) mg/l) was taken for sublethal studies according to Sprague (1971). Fish were exposed to acute concentration for 24 hours and sublethal concentration for 35 days. During sublethal exposure, fish were fed *ad libitum* and the toxicant was renewed daily, the physico - chemical parameters were monitored regularly to maintain at the same level. A common control was maintained. After 24 hours fish from acute concentration and from sublethal concentration at intervals of 7 days, were sacrificed with respective controls. Blood was drawn from heart by puncturing it using ice cold microsyringe. The whole blood was used for the estimation of erythrocytes, leucocytes and haemoglobin. Erythrocytes and leucocytes were counted using haemocytometer (Russia and sood, 1992). Haemoglobin content was estimated by cyanmethaemoglobin method (Drabkin, 1946). The significance between the sample mean of control and experimental fish was tested using students 't' test.

The data in Table 1, shows that during the acute treatment, erythrocyte, and leucocyte counts and haemoglobin content increased showing a per cent increase of 15.635, 16.29 and 15.689, respectively, at the end of 24 hours.

During the sublethal treatment, the erythorocyte count showed a significant decrease reaching a maximum decrease of 52.600% at the end of the 35th day. The decrease was directly proportional to the exposure period. The leucocyte count showed an increase throughout the exposure period showing a maximum increase of 41.74% at the end of the 14th day and a minimum increase of 1.0% at the end of the 16th day.

The haemoglobin content decreased throughout the experimental period showing a maximum decrease of 79.893% at the end of the 28th day.

The significant increase in the erythrocyte, and leucocyte counts and haemoglobin content during acute treatment is in confirmation with the works of Christensen *et al.* (1972), and Saxena and Chuahan (1994) in *Ictalurus nebulosus* and *Heteropeustes fossilis,* respectively exposed to acute concentration of copper. The increase in erythrocyte count may be due to the enhanced erythropoiesis which is triggered as a typical stress response (Gill and Pant, 1981) or asphyxia which rapidly leads to an increase in erythrocyte, haemoglobin and other constituents of the blood.

The significant increase in the erythrocyte count during acute exposure is probably due to the tissue damage and subsequent removal of cell debris (Mcleay and Brown, 1974) or for contributing to immunity as well as removal of necrotic tissues (cellular debris). A marked increase

Table 1 : Changes in the Erythrocyte, Leucocyte count and Haemoglobin content of fish *Cyprinus carpio* var. *communis* exposed to acute and sublethal concentration of copper sulphate.

Exposure	Erythrocyte (million/cu.mm)		Leucocyte (thousand / cu.mm)		Haemoglobin (g/dl)	
Period	Control	Experimental	Control	Experimental	Control	Experimental
Acute Treatment (24 h) (0.55 ppm)	1.535 ± 0.028	1.775 ± 0.010* (+15.635)	10.430 ± 0.000	12.130 ± 0.050* (+16.229)	5.029 ± 0.195	5.818 ± 0.028* (+15.689)
Sublethal Treatment (0.055 ppm)						
(days)						
7	1.500 ± 0.032	1.280 ± 0.030* (-14.667)	10.350 ± 0.037	13.300 ± 0.120* (+28.500)	5.200 ± 0.280	4.750 ± 0.060 (-8.654)
14	1.550 ± 0.032	1.230 ± 0.030* (-20.645)	10.300 ± 0.025	14.600 ± 0.040* (+41.748)	5.250 ± 0.140	8.750 ± 0.458* (-28.571)
21	1.550 ± 0.032	1.193 ± 0.118* (-23.032)	10.300 ± 0.025	10.880 ± 0.030* (+5.631)	4.255 ± 0.070	2.759 ± 0.093* (-35.159)
28	1.550 ± 0.032	0.880 ± 0.030* (-46.450)	10.290 ± 0.030	10.750 ± 0.020* (+4.470)	5.595 ± 0.124	1.125 ± 0.030* (-79.893)
35	1.540 ± 0.043	0.730 ± 0.030* (-52.600)	10.300 ± 0.032	10.400 ± 0.062 (+1.000)	5.060 ± 0.060	1.551 ± 0.044* (-69.307)

Values are mean ± SE of five individual observation. Values in perentheses are percent changes over control. - sign denotes percent decrease over control . + sign denotes percent increase over control. Degrees of freedom at 8t 0.05 = 2.306.

in haemoglobin content during acute treatment with copper sulphate may be a response to compensate impaired respiratory efficiency. A similar observation was reported by Chitra and Ramanarao (1986) and Rani (1999).

Erythrocyte level was found to be depressed in fishes subjected to stressful conditions. The reduction in erythrocyte may be caused either by the inhibition of erythropoiesis or by the destruction of red blood cells. Iwama *et al.* (1986) reported that the destruction of haematopoietic tissue in kidney and spleen could result in decreased blood cell production and subsequent reduction in erythrocyte count. During sublethal treatment in the present study, the decrease in erythrocyte count might have been due to the severe anemic state causally related to prolonged exposure to copper or the hemolysing power of the toxicant, particularly on the red cells as suggested by Ahmad and Munshi (1989).

Variations in leucocyte counts provide a better sensitivity index of stress than do changes in erythrocyte abundance (Mcleay and Gordon, 1977). Further, Nelson and Rani (1992) reported that the strength of a toxicant and the count of leucocytes are directly proportional. The increase in leucocyte count during the sublethal treatment in the present study may be due to leucocytosis, which is an adaptation to meet stressful condition by the animal. A similar observation as made by Sen *et al.* (1992) in *Channa punctatus* exposed to sublethal doses of zinc.

Heavy metal toxicity decreased haemoglobin level in many fishes. Sharma *et al.* (1995) observed that the reduction in haemoglobin content can be related to the decreased erythrocyte number, which indicates hemolysis, hemorrhage and reduced erythropoiesis. Sen *et al.* (1992) reported that the significant reduction in haemoglobin level in *C. punctatus* exposed to zinc toxicity during sublethal treatment may be due to anemia associated with erythropenia. In the present study also, loss of erythrocytes was observed during the chronic study and this may be the reason of anemia which reflects in the decreased level of haemoglobin.

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